

- **Renal Diseases**

, selective impairment of glomerular (like: nephrotic syndrome , diabetic nephropathy) or tubular functions

- **Major causes of renal diseases**

1- Pre-renal diseases : kidney قبل ال

2- Glomerular diseases

3- Tubular & interstitial diseases

4- Obstructive uropathies (pelvis to urethra)- stone , Obstruction to the flow of urine causes hydronephrosis

1- Pre-renal diseases

↓ blood supply to kidney:

Hypovolemia, hypotension, dehydration, ischemia

2- Glomerular diseases

- Nephritic pattern

Inflammation of Glomeruli, pus cells, proteinuria (mild to moderate in most cases).

- Nephrotic pattern (autoimmune)in basement membrane the pores became wider

- Example : diabetic nephropathy , nephrotic syndrome

Not inflammation, Proteinuria (Most cases heavy *albuminuria*) * more than 5g\24 hrs urine

Nephrotic syndrome: increase the permeability across the glomerular filtration barrier.

1- heavy *albuminuria : more than 5g\24 hrs urine

2- Hypoalbuminaemia : Serum albumin less than 3 g/dL– (N:3-5)

(major cause of Hypoalbuminaemia: liver disease or glomular dis >> urine : albuminuria)

3- Edema, puffy eye (clinical)

4- Hyperlipidemia: increased cholesterol in blood

3- Tubular & interstitial diseases

- Acute : acute tubular necrosis

- Chronic : polycystic kidney disease

Biochemical Investigations of kidney Functions

▪ Indications for assessing renal functions: (when do u request for KFT?)

Routine checkup, older age

(DM), (HTN)

Systemic infections, autoimmune disease (as SLE, etc)

Chronic renal diseases, (UTI)

Nephrolithiasis (renal stones)

Obstruction to the lower urinary tract (e.g. prostatic causes)

Drug toxicity

Glomerular Functions

▪ Measurement of GFR

- If glomerular is affected : the substance won't be filtered and it will be high in blood

Clearance Tests:

Accurate measurement of GFR by clearance tests requires:

- Freely filtered at glomeruli
- not reabsorbed not secreted by tubules.
- Its concentration in plasma remains constant throughout the period of urine collection.
- Better if endogenously.
 - Creatinine meets most of these criteria

1. Creatinine Clearance Test

Why Creatinine is used for testing clearance?

- Endogenously produced & proportional to muscle mass. creatine spontaneously converts to creatinine daily
- production is not affected by diet (no exogenous factors)
- Filtered at glomeruli at a constant rate.
- significantly reabsorbed by renal tubules

Dis adv: 10% of urinary creatinine is secreted by renal tubules (not significant) | so creatinine in urine comes from filtration and secretion (2 sources)

- **Normal range of creatinine clearance:**

About 110-120 ml/min in age of 20-40 years

Falls slowly & progressively to about 70 – 80 ml/min in ages over 80 year More in males

- **Plasma Creatinine Vs . Creatinine Clearance**

- Creatinine Clearance**

Not accurate its variable form age to another

It's concentration depends on factors like (it's concertation in urine and urine volume)

So **plasma Creatinine** is better accuracy ..

plasma creatinine effective in detecting late renal disease , enable the progress of renal disease to be followed

Remains constant throughout adult life

- **When do we depend on Creatinine Clearance is ONLY :**
 - **early renal disease**
 - kidney donors
 - Detection of renal toxicity of some nephrotoxic drugs

2. Inulin :

Better than urea but it's exogenous and the pt can be allergic to inulin so it's not ideal

Advantage of inulin clearance test over creatinine clearance test:

Small quantity of creatinine is reabsorbed and secreted but inulin doesn't.

3. Blood Urea

Metabolic product of protein catabolism

Non renal factors can **affect** the **urea level** (normal adults is level 5-39 mg/dl) as:

- Mild dehydration
- High protein diet (exogenous production factor)
- Increased protein catabolism (as in Cushing`s disease, DM, starvation, thyrotoxicosis)

Plasma creatinine provides a more accurate than blood urea because there are many factors that affect urea level rather than renal causes

4. Blood Uric Acid (what is the purpose ? : gout)

- **How does it produced?**

- Endogenous, end product catabolism of the purine bases in nucleic acids (DNA & RNA),
- exogenous: if you eat meat it will break down

- **Causes of hyperuricemia:**

- 1- **Overproduction** of uric acid:

- Excessive intake of diets containing nucleic acids (esp. red meat).

- Increased cellular breakdown (as in cancer therapy (chemo, radio)

- Genetic causes (as in Von Gierke`s Disease)

- 2- **Renal impairment** (glomerular diseases)

SO YOU HAVE TO EXCLUDE OTHER RENAL CAUSES FOR HYPERURICEMIA

5. Plasma β 2-microglobulin(expensive)

- 1- Small protein, completely filtered glomeruli

- 2- Present on the surface of most cells and in low concentrations in the plasma.

- 3- Complete reabsorbed & catabolized by proximal tubular cells.

Adv: (if high in blood = glomuri problem – so if tubule func , B2 is not clear in urin)

- ***Results of measuring blood levels of β 2-microglobulin:***

- 1- Blood level: GFR (glomular)

- 2-urine level of assessing tubular functions.

- 3- BUT:

- It is **increased** in **certain malignancies** and **inflammatory** diseases. (rare)

Tubular Functions:

1. Urine Osmolality Measurements

Osmolality: weight of solutes/ weight of solvent

A patient with (tubular defect) polyuria due to chronic renal failure.. Osmolality will reduce , so it became diluted urine, cus solvent will increase , cus it can't reabsorb the water

So measure Urine osmolality , assess tubular func

Normal kidney can concentrate urine

So renal failure , will not be able to concentrate urine , the color of urine is pale like water ...

Urine osmolality is higher than blood

- **Renal tubular functions is assessed by:**
 - Urine Osmolality Measurements
 - Urine pH, Volume, Urine Appearance & Colour
 - Urine Protein Amount
 - (Glucosuria) hyperglycemia or tubule problem: renal glucosuria (tubule defet)
 - (Aminoaciduria) aminoaciduria due to inborn errors of amino acids metabolism or it production is high in blood, not reabsorbed tubular defects.

Proteinuria

Normal: less than 200 mg/24hours

Proteinuria: if it increases than 200 mg/24hours

Mild 1g\24 hrs urine

Moderate 1-3 g\24 hrs urine

Sever 3-5\24 hrs urine

Heavy: ^5 \24 hrs urine= nephrotic syndrome diabetic nephropathy

▪ Types of proteinuria

1. Glomerular proteinuria

- Increased filtration of high molecular weight proteins (such as albumin)
- *Example:* (heavy)
 - 1- Diabetic nephropathy
 - 2- Nephrotic syndrome

2. Tubular proteinuria

Normally: Smaller molecules (including smaller proteins & amino acids) can be filtered completely reabsorbed in the proximal tubule.

- In tubular diseases:
 - increased excretion of smaller proteins & amino acids (aminoaciduria)
 - β 2-microglobulin**, if in urine : tubular disease

3. Overflow proteinuria (load is large on kidney so excreted amount will be large)

- Increased excretion of low molecular weight proteins , overproduction of certain protein
- This is due to (almost all causes):
 - 1- Immunoglobulin light chains in multiple myeloma
 - 2- Hemoglobin in intravascular hemolysis (G6P deficiency) – red urine